Executive Summary

California's forests and rangelands are a vast and cherished part of the state's heritage and key to its future. These lands cover over 80 percent of the state and are set in the context of a largely urban population with distinct regional economies. These lands provide impressive biological diversity, scenic views, open space, wildlife habitat, recreation, timber, forage, and water. In recent decades, California's economy has grown, diversified, and become integrated into global trade and competition. At the same time, population, income, and mobility have increased, creating greater demands for the goods and services provided by shrinking forests and rangelands.

How is it possible to understand all of the various dimensions of these lands? What policies will lead to optimal use of forest and rangelands while at the same time ensuring their long-term sustainability? The California Department of Forestry and Fire Protection and its partners provide this assessment as the basis of information for a continuing dialog to answer these questions.

Maintaining forest and rangeland sustainability requires addressing environmental, economic, and social factors together.

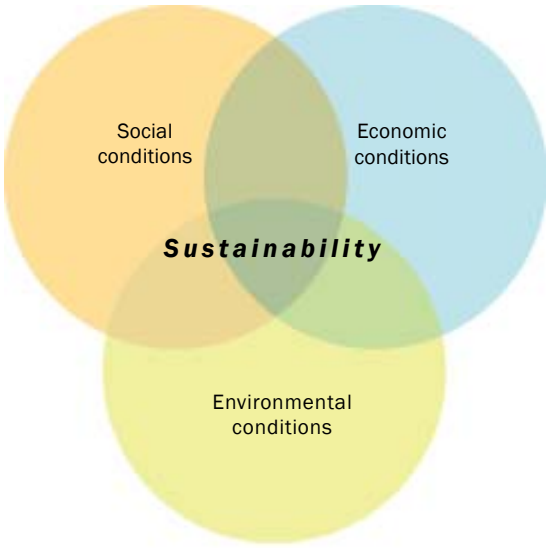
Assessment Content

The Forest and Range 2003 Assessment provides a systematic overview of the status, trends, and challenges to California's forest and rangeland resources. The Assessment is not a plan; it summarizes current knowledge, projects future conditions, and underscores potential problems and opportunities.

The Assessment comprises a comprehensive series of on-line technical reports on over 30 topics relevant to environmental, economic, and social conditions that are the foundation of resource sustainability (Figure 1). The Assessment flagship product, "The Changing California: Forest and Range 2003 Assessment," summarizes information from these technical reports. It focuses on status, trends, and factors affecting sustainability, while framing policy issues and options for consideration by the California State Board of Forestry and Fire Protection as well as other policy makers.

A number of information systems created by the Fire and Resource Assessment Program (FRAP) support the assessment analysis and provide rich information for further research, analysis, and dialogue. This information is available through the FRAP web site and includes Geographic Information System (GIS) data, maps, tabular databases, technical reports, and links to related external publications. All of these will be continually updated as new information and analyses become available.

Figure 1. Sustainability of forests and rangelands



Assessment Framework

FRAP incorporates all the mandated requirements of Public Resources Code 4789 and delivers it in a contemporary framework focused on measurements of sustainability. Fifteen years ago, sustainability was simply defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Commission Report, 1987). As many groups began to work on defining sustainability, it became clear that three very different sets of conditions or indicators—environmental, social, and economic—needed to be included (Figure 1). While the desire may be to have very positive indicators for all three themes, objective assessments document a range of current conditions as well as many potential approaches towards improving overall sustainability in the future. The value of an objective framework for sustainability is that it provides all stakeholders with valuable information for assessing future decisions and policies.

For this assessment, FRAP followed the Montréal Process framework that is a set of criteria and indicators used to measure sustainable forest management for non-tropical forests. It was designed under the auspices of the United Nations and is now used by the U.S. Forest Service, the state of Oregon, and a number of other entities (USFS RPA, 2002; ODF, 2003; USFS, 1997). The Montréal Process was the result of initial efforts by the 1992 United Nations Conference on Environment and Development and led to the 1994 formation of the Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests in Geneva (see page 30 for more on the Montréal Process).

The assessment indicators are organized around seven themes:

1) biological diversity
2) productive capacity
3) forest health
4) soil conservation and water quality
5) forests and climate change
6) socio-economic benefits
7) governance

California's Forests and Rangelands—A World of Change

In the 1990s, a number of factors altered the context of forest and rangeland issues. Continued population growth, environmental and regulatory costs, global competition, trade, and technology became even stronger forces. While Silicon Valley and Hollywood are the largest and most visible symbols of California's global role, the same forces driving global integration have an impact on the forest and rangeland regions of California. Local availability of natural resources is no longer the major source of competitive economic advantage for the State's forest and rangeland dominated regions. Technology, research and development, and new commodities that add value and adapt to distant markets now give the competitive edge.

California's first Forest and Rangeland Assessment in 1978 did not cover world or national trade trends in detail. The 2003 Assessment cannot avoid it. Markets, production, and investment decisions in the forest products and range livestock industry in California are influenced by global factors. Global production networks and information and trade flows are at the center of many of these influences.

There has been an increasing connection between world trade and environmental issues since World War II. In varying forms, the concept of "sustainability" has come to dominate both environmental and trade discussions. In the early 1990s, there was an upwelling of concern regarding global environmental degradation and the promotion of socio-economic development. Examples of global concerns have been deforestation, loss of biological diversity, climate change, and extinction of species. These concerns led to a series of international conferences and agreements whereby nations set out frameworks to deal with trade and environmental issues. In addition, an intricate interconnected network of governments, international agencies, non-government organizations (NGOs), and multinational businesses has evolved in support of sustainability and related programs.

Stout Grove, Jedediah Smith Redwoods State Park: G. Donald Bain, Geo–Images Project, UC Berkeley

At both the international and national level, the U.S. government has promoted agendas that pursue economic growth in the broader context of sustainable development, integrating economic, social, and environmental policies. Federal agencies have been mandated to pay more attention to ecological, wildlife and watershed considerations in their decision-making. NGOs, especially land trusts and foundations that have an interest in the environment, have grown substantially.

From a legal perspective, each state has also developed its own set of institutions and laws to manage forest and range issues. California's framework is a mix of historical and new approaches. New approaches and tools for managing forests and rangelands are strongly driven by the urban nature of California and its rapidly changing demographics.

Compared to a decade ago, there are hundreds of groups in California with an interest in forests and rangelands. These include landowner groups, watershed groups, restoration groups, land trusts, and fire safe councils. Networking and information sharing over the web are also extensive. A number of these collaborations have worked well while others have been more difficult. When federal or state agencies are required to be involved, new tensions are added to the existing differences among local stakeholders.

During the 1990s, there has been more emphasis on agency cooperation and greater public and multi-stakeholder involvement. Greater collaboration and cooperation has been attempted between all combinations of federal, state and local governmental agencies, the public, and Native American communities in California. This has not always been easy, as stakeholders are sometimes resistant to change and power sharing. Cooperation between federal agencies is often required by law, executive order, memorandum of understanding (MOU), or executive program, and is most successful when organized around common goals.

While Californians possess extremely diverse viewpoints concerning appropriate methods of forest and rangeland use and management, nearly all are supportive of conservation. This fact is reflected in the growth of land trusts during the last decade. Such trusts were created for a variety of protective purposes such as open space, farm and working forests, endangered species and habitat, and watersheds. According to the Land Trust Census, in 2000, California had 132 land trusts protecting 1.25 million acres. Applying national percentages of the proportion of farmland and rangeland trusts (46 percent) to California, between 500,000 and 600,000 acres of trusts are devoted to the protection of farmland and rangelands.

State conservancies also support land trusts. California has authorized seven State conservancies. Each is a subunit of the California Resources Agency. One goal of conservancies is to purchase and protect undeveloped lands that are threatened by development and develop appropriate management plans for their use. A strength of State conservancies is that they apply statewide resources to protect assets in a specific geographical area of high public value.

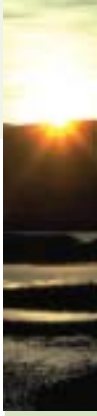
Emerging global changes in California's forests and rangelands include:

- **Competitive global setting**
- **Forestry from sustainability perspective**
- **Ever increasing public interest**
- **Adaptive governance structures**

While money originates from a wide variety of sources, funding for easements or other forms of land conservation usually stems from shared private, non–profit, and public resources. Landowners usually are compensated in the form of cash and/or tax credits for donating conservation easements. Proposition 40 (the California Clean Water, Clean Air, Safe Neighborhood Parks, and Coastal Protection Act of 2002) was passed by 57 percent of the voters in March 2002, despite a recession, and is providing $445 million in funding for these conservancies over five years.

In this context—a competitive global setting, forestry from a sustainability perspective, ever increasing public interest, and emerging adaptive governance structures—the Forest and Range 2003 Assessment is presented.

Old stage road through Sequoia grove, Yosemite National Park: G. Donald Bain



Two Decades of Change on California's Forests

Changing population, society values, and institutions

The social setting of California's forest and rangeland has changed radically since the late 1980s. The State's growing population consumes increasing amounts of forest and rangeland products. At the same time, Californians increasingly demonstrate values and concerns that are redirecting the use of forest and rangeland resources towards more environmental considerations. Accomodating these shifting values requires innovations in resource management, significant reductions in commodity outputs or both.

Continued population growth adds to concerns over water quantity, water quality, preservation of open space and habitat, species extinction, and wildfire risk. Implementation of the Federal Endangered Species Act, Clean Water Act, and Clean Air Act have made the provision of biological diversity, conservation of species habitat, and protection of air and water quality increasingly important forest and rangeland management themes—especially on public lands.

As a result of these emerging themes, the framework of laws and governmental structures that existed in the 1970s and 1980s has been stretched. Through litigation, ballot initiative, private sector innovation, legislative action, and administrative implementation a variety of modified and even new institutions have emerged. These include coordinated agency and private projects, watershed groups, fire safe councils, land trusts, and other non–profit organizations. Additional approaches, such as habitat acquisition, working forest and other conservation easements, forest certification, and trading of carbon credits are also being integrated into business operations.

Understanding how these themes play out requires that analysis be done at the watershed and landscape levels, using information systems to provide the full range of necessary data and analyses. Application of science, research, and technology transfer are becoming increasingly important as the methods are still evolving.

Many of these changes show up in the evolving status of the forest products industry and related employment. They can be seen in the decrease in the area available for timber production, decreased timber harvests, declining mill numbers and capacity, increased unemployment, and restructuring of local economies and revenue.

A major issue for the future of California's forests and rangelands relates to public perceptions of the appropriate mix of private investments, regulation, public investments, and governance processes needed to achieve desired goals. In public opinion polls, an overwhelming majority view overall environmental problems such as air and water pollution, growth, traffic, and water supply as a threat to their health and well-being. Residents also believe that insufficient progress has been made over the past 20 years in solving environmental problems. On forestry-related issues, a 2000 survey by the Public Policy Information Center found that nearly half of the respondents said that urban growth and air pollution damage to the forests in the Sierra Nevada mountains are a "big problem," and an additional third were "concerned." Moreover, approximately one-third had significant concerns regarding the logging of old growth redwoods in the North Coast, while two-thirds of the respondents rated the issue at least "somewhat of a problem." Innovative strategies to address these concerns and communicate successful approaches to the public will be required from both public and private organizations.

Significant changes to California's forests over the last decade include:

- **Increasing consumption of forest products and water**
- **Increasing focus on watersheds, open space, wildfire, and endangered species habitats**
- **Decreasing production of forest products**
- **Increasingly complex interactions among owners, regulators, and stakeholders**

Changing forest conditions and structures

California's forests provide a wide range of values including scenic vistas, recreation opportunities, wildlife habitat, watershed function, commodity forest products, and other uses. A long history of creating parks, wildlife reserves, and wilderness areas in our forests has endowed California with the highest percentage of forests in reserve status of all states, with the exception of Alaska. Old growth forests—primarily in parks, reserves, and national forests—constitute approximately 15 percent of California's conifer forests. In terms of both total area and as a percentage of total forest area, this is roughly twice as large as the equally renowned old growth forests of the Pacific Northwest region.

Across all 31 million acres of California's forests, there is a broad range of tree species, tree sizes, and levels of canopy closure. Conifer forests and woodlands cover over 21 million acres and are most extensive in the Sierra, Modoc, and Klamath/North Coast bioregions of the State. Hardwood forests and woodlands cover nearly 10 million acres and extend along the perimeter of the Sacramento and San Joaquin Valleys and throughout the coastal ranges.

Two dominant characteristics of California's conifer forest are the prevalence of medium size trees and dense forest stands. Forty-five percent of the conifer forest area in California is found in the 11 to 24-inch average stand diameter size class. By comparison, 31 percent of the area is in larger size classes, 17 percent of the area is in smaller size classes, and seven percent is unclassified. In terms of canopy closure, 53 percent of conifer forest is classified as having dense canopy closure (greater than 60 percent closure).

The most productive timber growing portion of California's forests are the 16.6 million acres of public and private timberland—that is, land capable of growing more than 20 cubic feet of wood per acre per year and statutorily available for timber management. In the case of public ownerships (56 percent of timberlands), many lands capable of timber production have been administratively withdrawn over the past two decades for a variety of purposes and have been directed to primary uses other than timber production.

California's forests are improving from a perspective of an increase in growing stocks, sustainable harvesting, and the presense of a wide diversity of forest structures. However, increasingly dense forests can lead to forest health concerns.

California has 7.3 million acres of privately owned timberland, of which 5.4 million acres are classified as timberland production zone (TPZ) where long term tax and regulatory structures favor timber production over potential conversion to other uses. Large private ownerships are most likely to grow and harvest timber on a continuing basis. Smaller owners are much more varied and typically also have numerous non-timber related management goals. Increased planning requirements, operational limitations, and habitat protection have increased the expense of timber growing and harvesting on private land.

While extensive, the total area of timberlands is slowly declining. Between 1984 and 1994, about 250,000 acres of the total timberland base, outside of national forests, were removed from production. The leading cause was change to Reserve status (e.g., wilderness, ecological reserves, parks, and open space uses). A smaller amount (approximately 76,000 acres) was converted to non-timber uses (housing, roads, agriculture) from 1984 to 1994, but many more acres were effectively removed from timber production due to fragmentation of ownerships and growing residential uses. Land use data since 1994 does not specifically separate out timberlands, but the overall trend of conversion is continuing (Waddell and Bassett, 1996 and 1997).

The overall status of California's remaining timberlands in terms of total inventory is improving. While the average volume of growing stock per acre on all ownerships declined from the 1950s through the 1970s, it has been increasing since then. In 1994, California's timberland inventory, the volume of growing stock on timberland, consisted of a net volume of approximately 55 billion cubic feet. National Forest lands have over half of the growing stock, but private industry forests hold the most productive tree growing sites and have higher

growth rates. Overall, private industry timberland volume inventories are growing at a 2.8 percent annual rate, while rates for other owners vary from 2.0 to 2.3 percent.

Whether looked at on a volume basis or an area basis, California's timberlands have significant resources in stands dominated by trees over 100 years old. Across all ownerships, over 22 billion cubic feet (41 percent) is in stands less than 100 years old while, more than 32 billion cubic feet (59 percent) exist in stands greater than 100 years. National Forest timberlands have a higher percentage of their growing stock in stands greater than 100 years (88 percent) as compared to private timberlands (25 percent). Across all ownerships, there are about eight million acres of timberland in stands under 100 years old and eight million acres of timberland in stands older than 100 years. Seventy-nine percent of national forest timberland area is in stands greater than 100 years old and 22 percent of private timberlands is in stands greater than 100 years old (Waddell and Bassett, 1996 and 1997).

Siskiyou Pass, Six Rivers National Forest: G. Donald Bain

The silvicultural methods used by forest managers continue to shape forest conditions. Silviculture is the theory and practice of controlling the establishment, composition, and growth of forest stands. A silvicultural system is a program of forest stand treatments during the life of the stand and includes the development of young trees that will grow over time. Thousands of forest land acres are established or regenerated by natural processes, planting, or seeding each year. Forest composition and growth can be managed by stand improvement practices such as thinning and vegetation control. For example, growth of new or existing trees can often be increased by the removal of adjacent trees that are competing for water, soil nutrients, and light. The Forest Practice Rules (FPRs), which apply to non-federal timberlands in California, describe and regulate standard silvicultural systems with details about regeneration methods, intermediate treatments, alternatives, and limitations.

There is a mixture of uneven and evenaged forest structure on both private and public timberland. In the unevenaged stands, only some of the trees are harvested in any entry and the remaining stand has a mixed aged of trees. Evenaged harvesting practices, which include clearcutting, seed tree, and shelterwood systems, are designed to replace a harvestable stand with well–spaced, growing trees of a uniform age in a single harvest operation (clearcutting) or multiple harvest operations (seed tree and shelterwood). Evenaged harvests represent about half of the total private harvest area in California, and are a controversial issue—particularly by clearcutting. The percentage of total area harvested that was clearcut has increased from 3.6 percent in 1993 to around 15 percent in 2002 (Table 1) (Cunningham, 2003).

On one hand, evenaged harvesting systems can increase habitat for certain species that benefit from open area, reduce the spread of insects by removing brood material, lessen the risk of wildfire by reducing fuel loading and continuity, and improve the growth rate of some types of forest stands. Negative aspects include

Table 1. Total harvest area, clearcut harvest area, and percentage of area clearcut harvested for approved Timber Harvest Plans on private and state lands, 1993–2002 (thousand acres)

Harvest area (thousand acres) or percentage	Year									
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total area	276	252	260	390	240	238	271	182	180	208
Clearcut area	10	13	18	24	25	28	47	29	25	31
Percentage clearcut	3.6	5.1	6.9	6.2	10.4	11.8	17.4	15.9	13.9	14.9

Source: Cunningham from Forest Practices Database, 2003.

visual impacts, loss of forest "biological legacies" and habitat structures such as snags and down logs, and localized intensity of harvest operations.

Over coming decades, it is possible that use of clearcutting or other evenaged systems may increase somewhat in the Sierra in stand conditions where current growth is below potential due to past harvesting and wildfire suppression efforts. In many stands, the practice of "high grading" removed most of the valuable pines and larger trees of all species and left diminished vigor in the remaining stand. This harvesting practice, together with successful wildfire suppression efforts, often caused stand composition to shift to less economically valuable species such as white fir and incense cedar. Many stands, especially in the Sierra, are in this condition and some land managers are considering the use of clearcutting or similar techniques to regenerate the stands to achieve better use of the site for desired tree species.

Forest managers are also considering other techniques such as variable retention, mixed evenaged, and small group selection that can achieve similar productivity levels while simultaneously achieving other desired goals of wildlife habitat, visual, aesthetics, and harvesting intensity. Variable retention has been increasingly used in the Pacific Northwest and British Columbia, and involves retaining the structural elements of the harvested stand for at least a full rotation. This harvesting method is flexible and can lead to evenaged, multi-aged, or unevenaged stands. The spatial pattern of the retained trees may follow stream courses, focus on unique wildlife habitats, or be spread throughout the stand.

In all regions of California, net annual growth of timber exceeds annual harvest on both private and public timberlands. The ratios of annual growth to harvest on private timberland are shown in Figure 2. For example, the growth/harvest ratio of 1.52 for the Sacramento region indicates that growth on private timberlands in this region was slightly over one and one-half times as high as harvest. Localized conditions may vary greatly from these generalizations. In some places, large portions of watersheds have been harvested during the recent decades and considerable public concern has been generated in the areas where recent harvest rates

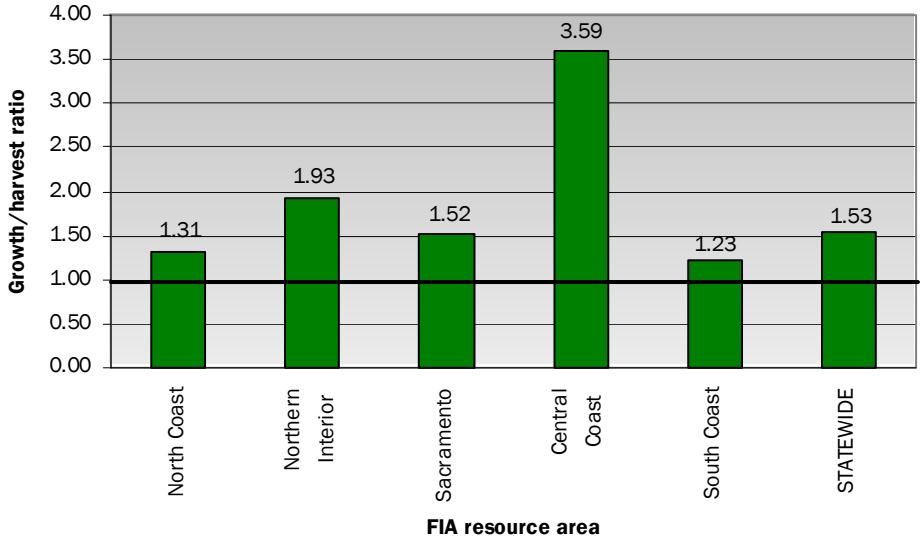
Variable retention silviculture in Jackson Demonstration State Forest.

exceed growth rates. In many other areas the continued increase in stand density, and more importantly, in surface fuel levels, presents an increasing challenge to the maintaining healthy forests and minimizing the risk of wildfire. Wildfire threats to urban interface communities, increasing forest density, and the synergistic effects of drought, pests, and other environmental influences are significant challenges to the health of California's forests.

An increasingly important aspect of forests' health is their relationship to protecting and improving water quality of the streams and rivers that travel through them. In addition to requiring higher levels of forest canopy along stream courses, there is increased investment in projects to improve fish habitat and reduce levels of sediment input to watercourses. These investments have been concentrated in watersheds with less stable terrain and where populations of salmonids such as Coho salmon, Chinook salmon, and steelhead trout are low. While conditions vary from watershed to watershed, most sediment analyses have identified road systems, and associated stream crossings and drainage systems, rather than the in-harvest operations, as the major sources of additional sediment. New investments are aimed at improving forest road systems to reduce impacts to water quality.

Wildfire threats to urban interface communities, increasing forest density and synergistic effects of drought, pests and other environmental influences are significant challenges for the health of California's forests.

Figure 2. Ratio of growth to harvest on private timberlands by FIA resource area and statewide, 1984–1994



Source: compiled by FRAP from Waddell and Bassett, 1996 and 1997

Changing forest economics

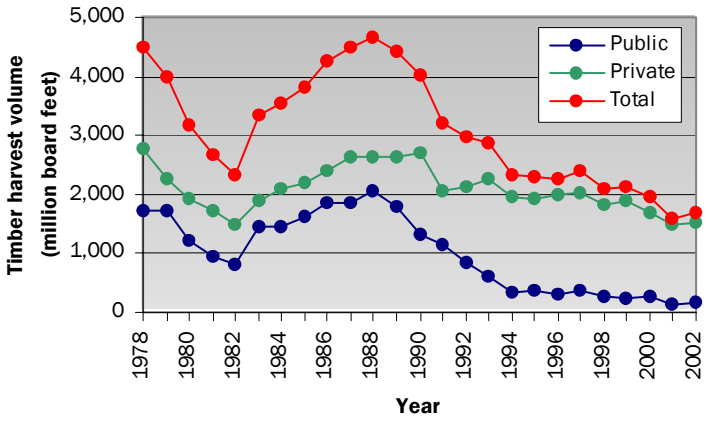
Many broad social changes are affecting the economic status of the forest products industry and related employment. These include increasing consumption, declining timber harvest outside of plantations, declining number and capacity of mills, and declining timber-related employment in forest regions. On the consumption side, Californians use increasingly larger quantities of forest products, water, energy, and other forest values such as recreation. The consumption of lumber and paper products increases as population grows and California's population is projected to increase. California could produce most of the forest products it consumes if the majority of timberlands were managed for wood products production. However, due to a wider set of management goals for public and private forests, most wood products are now supplied by imports from other states and countries.

During the past half century, timber harvesting on both public and private lands in California has fluctuated considerably. Timber harvest volume in California increased from four to six billion board feet between 1948 and 1955, but has declined since then. Timber harvest volume on public lands has declined dramatically since 1989 (Figure 3) and recent harvest levels are now less than 0.2 billion board feet per year. Harvest on private lands has declined since 1990, though not as steeply as on public lands, reaching the lowest level in more than a decade in 2001.

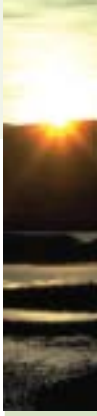
As a result of declining timber supply, global competition, and production efficiencies, production of timber products in California has changed significantly. California imports nearly all of its paper, pulp and structural wood products and although lumber remains the dominant forest product produced from trees grown in California, the number of sawmills has declined from nearly 100 large mills in 1988 to less than 40 in 2002. Related employment has also declined as sawmills have installed more efficient equipment better suited to handling smaller diameter trees and have reduced operating hours as harvest levels declined. Employment related to the forest products industry in most rural counties has also declined as local economies have lost forest products as a viable economic contributor. The negative impacts have been most noticeable in smaller counties far from regional transport corridors.

As sawmill employment has declined, the wood remanufacturing industry has become the major employer of timber–related workers in California. Remanufacturing employment fluctuates with consumer demand and is typically located closer to the final markets in urban areas. Within California, wood remanufacturing employment (e.g. mill work, windows and doors, and moulding) is primarily located in southern California. Almost 70 percent of California's wood products-related employment is now in the five counties of Los Angeles, Orange, Riverside, San Bernardino, and San Diego.

Figure 3. Volume of timber harvested on public and private ownerships, and total, 1978–2002



Source: California State Board of Equalization, 2003



In addition to providing wood products, forests are the source of a significant portion of the state's surface water. While water runoff is not managed as a commodity until it is diverted into reservoirs, canals, or pipelines, it is the state's most important natural resource. The importance of water lies in the fact that it is an essential, non–substitutable commodity needed for human survival. Usable water is a scarce resource in many parts of California, and water deficiencies (droughts) and excesses (floods) are recurring problems. Water represents the state's most economically valuable natural resource and is essential for ecological functions.

Most headwaters of California's streams and rivers are found within forested landscapes, both publicly and privately owned. More than 70 percent of the average annual runoff of 71 million acre-feet originates north of Sacramento. In contrast, about 75 percent of California's urban and agricultural water demands lie south of Sacramento (Department of Water Resources, 1998). Water is often transferred from one watershed or hydrologic region to another to meet these demands which are located in low rainfall agricultural and metropolitan regions.

The supply of water was insufficient to meet all demands in 1995 and is projected to be consistently insufficient by 2020, especially in low rainfall years. Periods of drought will exacerbate problems in meeting demand for water. Since the 1990s, use of water for environmental purposes has gained increased importance, but urban uses are projected to account for nearly all the projected increased demand for water by 2020 (Department of Water Resources, 1998) (Table 2).

From an economic perspective, the sale of wood products remains the only end use that generates the level of funds necessary to cover land ownership and management expenses, yet economic output and the associated employment levels associated with timber harvest have declined during the past decade. While forests will continue to play an important role in provision of water runoff and the protection of water quality, the economic linkages between society's downstream demands and upstream management costs remain weak.

Table 2. Applied water use in average water year conditions, 1995 and 2020 (million acre-feet)

Water use	1995	2020 *(projected)*	Change
Urban	8.8 (11%)	12.0 (15%)	+3.2 (+4%)
Agricultural	33.8 (43%)	31.5 (39%)	–2.3 (–4%)
Environmental	36.9 (46%)	37.0 (46%)	+0.1 (0%)
Total	79.5	80.5	+1.0

Source: Department of Water Resources, 1998

Two Decades of Change on California's Rangelands

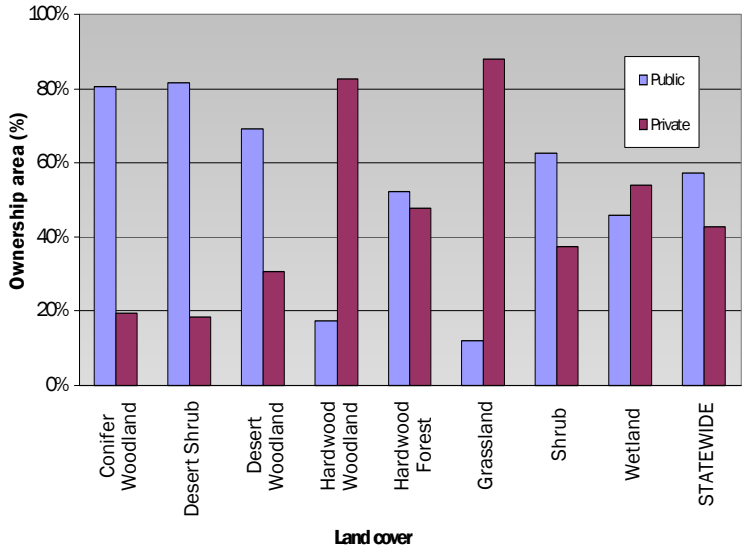
On an area basis, rangelands are the largest resource use designation in California. The State's total area of primary rangeland most suitable for grazing exceeds 57 million acres, or over one-half of the state. Approximately 34 million acres are actually grazed and are a vital part of the cattle and sheep industries in California. In addition to seasonal grazing, rangelands provide benefits such as wildlife habitat and recreational opportunities, at relatively little cost to Californians. In particular, near urban areas rangelands provide open space, viewsheds, and related values.

Cattle grazing in Hardwood Woodland and Grassland land covers

Significant shifts in plant species composition of rangelands have occurred since the late 1800s. Early changes were driven by heavy grazing, severe drought, introduction of large fires for forage improvement, and livestock impacts to aquatic/riparian areas (Kinney, 1996). Over the last two decades, large scale change in livestock management has substantially contributed to recovery of previously degraded landscapes. Where threatened or endangered wildlife and plant species overlap rangelands, some lands have been set aside or restricted in use in an effort to prevent further species loss. Riparian habitat and water quality issues are being addressed on some private ranches as part of Rangeland Water Quality Management Plans, developed by landowners to improve water quality under the federal Clean Water Act.

Rangeland ownership is dominated by public ownership (57 percent) in terms of total area, but productivity and use rates are considerably higher on private lands. Rangeland consists of different vegetation cover types and the ownership of these types differs between the private and public sector (Figure 4).

Figure 4. Percentage area of primary rangelands in public and private ownership by land cover class



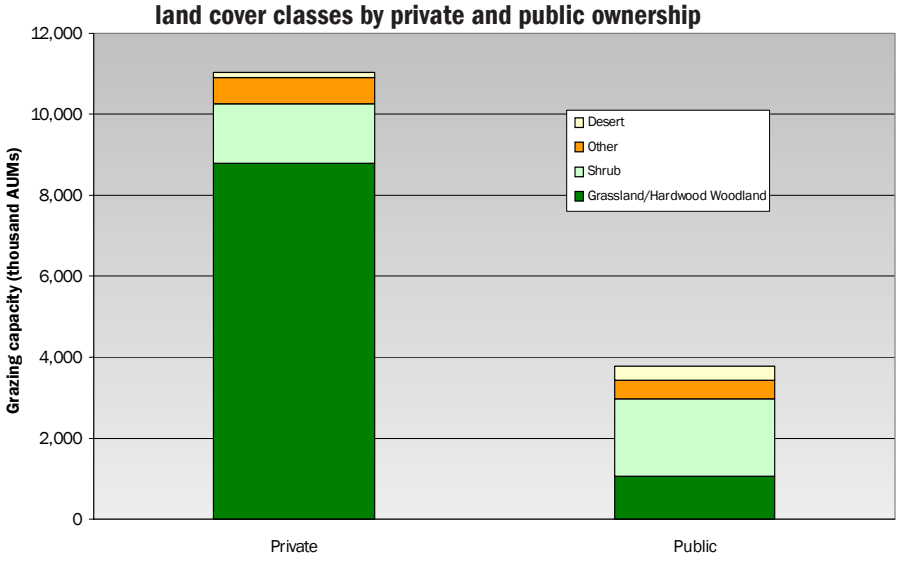
Source: FRAP 1999; FRAP, 2002d

Annual grasslands (including those within Hardwood Woodland types) are the most important source of range forage and provide over two-thirds of the forage for domestic livestock. California's hardwood rangelands also have historically been one of the most important rangeland areas in the State, providing a substantial portion of California's rangeland grazing capacity. Private lands provide the dominant amount of forage for grazing, as expressed by Animal Unit Months (AUMs) of grazing capacity (Figure 5). While the area of rangelands available for grazing is evenly distributed between private and public land, private lands provide nearly three times more AUMs for livestock and wildlife grazing.

With the exception of deer migration and other wildlife habitat, rangelands have been seen traditionally in the context of the State's cattle and sheep industries. In 1990, 40 of the State's 58 counties listed cattle and beef among the top five agricultural commodities in terms of gross value. Major rangeland commodities include animals, meat, wool, and a host of related byproducts. Despite widespread diversification of California's economic base over the past decade, cattle and beef were still among the top five commodities in 33 counties in 1999. California's cattle and sheep industries remain significant compared to those in other states.

California is a net importer of beef and other major rangeland commodities. Beef consumption in America has declined as consumers turn to chicken, turkey, and fish although this decline seems to have stabilized in recent years (U. S. International Trade Commission, 1999). Based largely on increases in population growth, total consumption of beef in California is projected to increase over the next decade. Livestock is increasingly a global industry, with many countries importing and exporting livestock and livestock related products. This global movement of animals and meat makes the livestock industry very susceptible to transport of disease. Concerns over two diseases have recently dominated the U.S. and international arena: foot–and–mouth disease and mad cow disease. Neither disease currently exists in the United States. California has taken extra precautions to be able to detect and respond to any potential outbreaks.

Figure 5. Grazing capacity in Animal Unit Months (AUMs) of land cover classes by private and public ownership



Source: CH2M-Hill, 1998; FRAP, 1999; FRAP, 2002d; National Agricultural Statistics Service, 2001a;

Cattle sales exceeded $630 million in 1997, much of which came from larger ranches in the San Joaquin and southern California desert regions.

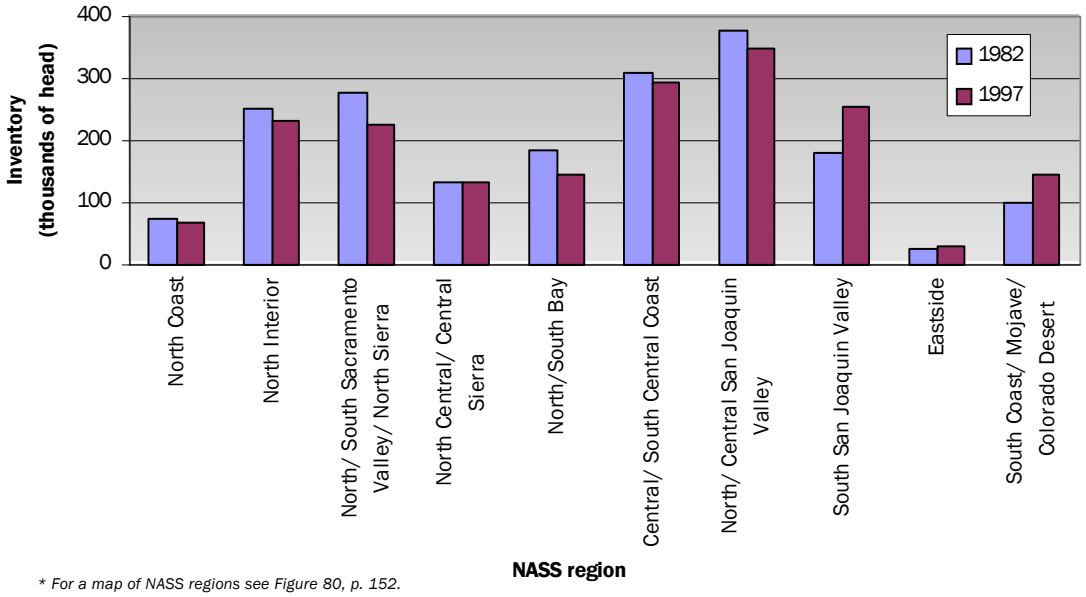
Livestock production from forest and rangelands consists primarily of beef cattle and some sheep and lambs not in feedlots. Over half of the beef production is concentrated on larger farms and ranches. According to the National Agricultural Statistics Service (NASS), the total number of rangeland farms declined 22 percent between 1982 and 1997, with the majority of the decline being in farms less than 500 acres in size (NASS, 2001a). During this time the inventory on rangeland beef cattle farms varied by region, but statewide has remained stable with approximately two million head (Figure 6). Sales from rangeland farms were almost $630 million in 1997, a four percent decrease from the 1992 levels. Almost half of total sales value comes from farms 2,000 acres or larger.

The inventory of sheep and lambs in California fluctuated over the last decade, ranging from a high of 1.1 million animals in 1994 to a low of 800,000 in 1998. Total production of sheep and lambs in California for all farm types over the last decade varied from 92 million pounds in 1993 to 47 million pounds in 1999. Roughly half of the sheep and lamb crop is sold annually. Wool production declined from 7.6 million pounds to four million pounds between 1990 and 2000. Total gross income declined from $85 million in 1996 to $42 million in 1999.

In the opinion of some observers, California's range industry is at a crossroads. Many operators are nearing retirement age and could soon exit the industry. At least four key factors drive change and uncertainty on California's rangelands. One is the generally challenging economic context of ranching, which is common to the livestock industry in other parts of the United States. Another is changes in management of public rangelands with a marked decline in availability. A third is increasing cost of regulations for a variety of public goals. A fourth is the impact of population growth on land values, on perceptions of ranching, and on redefining the goods and services that are expected of rangelands. This impact is more noticeable in urbanized states such as California.

Within the context of California's range economy, grazing enterprises can be quite risky. Livestock, hay, and other input prices fluctuate annually. In addition, forage production may vary greatly due to differences

Figure 6. Cattle and calf inventory on beef cattle farms excluding feedlots by NASS region*, 1982 and 1997



** For a map of NASS regions see Figure 80, p. 152.*
Source: National Agricultural Statistics Service, 2001a

in rainfall and temperature. These factors create substantial annual variation in returns. The ability of a rancher to deal with the risk depends upon available financial resources, borrowed capital, interest rates, and management approaches. Additionally, the processing sector remains outside of California and market opportunities, especially for smaller producers, may be limited.

As one measure of profitability, prices received for cattle have declined about 10 percent over the last decade while costs of inputs (primarily feed and livestock acquisition costs) used by domestic cattle producers have risen about 12 percent. To a degree, California and other American producers have been able to offset lower costs in other nations by increasing efficiency and productivity, creating new products, and developing niche markets. However, costs are still well above those in other competing countries.

In some cases, viability of existing ranching operations has been affected by changes in grazing policies by public agencies. As part of a broader policy of ecosystem and watershed management, public agencies have placed less emphasis on commodity production and more emphasis on rangeland restoration through limitations on grazing and implementation of restoration projects. This approach has decreased the availability of forage allotments from federally owned lands and increased the uncertainty of forage supply to ranchers who have historically depended on it.

Operating in an increasingly urban state, California agriculture faces public concerns over food safety, health, pesticide use, clean water, clean air, groundwater contamination and replacement, open space, worker safety, and ecosystem and wildlife preservation. At the State level, ranchers face increased health requirements, management practice limitations, and acquisition of habitat by public agencies or other entities. At the local level, impacts include increased land use conflicts; more complaints over noise, traffic, odor, and dust; livestock damage from stray pets; and more restrictions on management options. The net result is usually additional costs of ranching. While many ranchers are very adept at dealing with these pressures, the probability of conversion to residential or commercial uses increases when ranching becomes no longer cost effective.

Photo courtesy of Natural Resources Conservation Service.

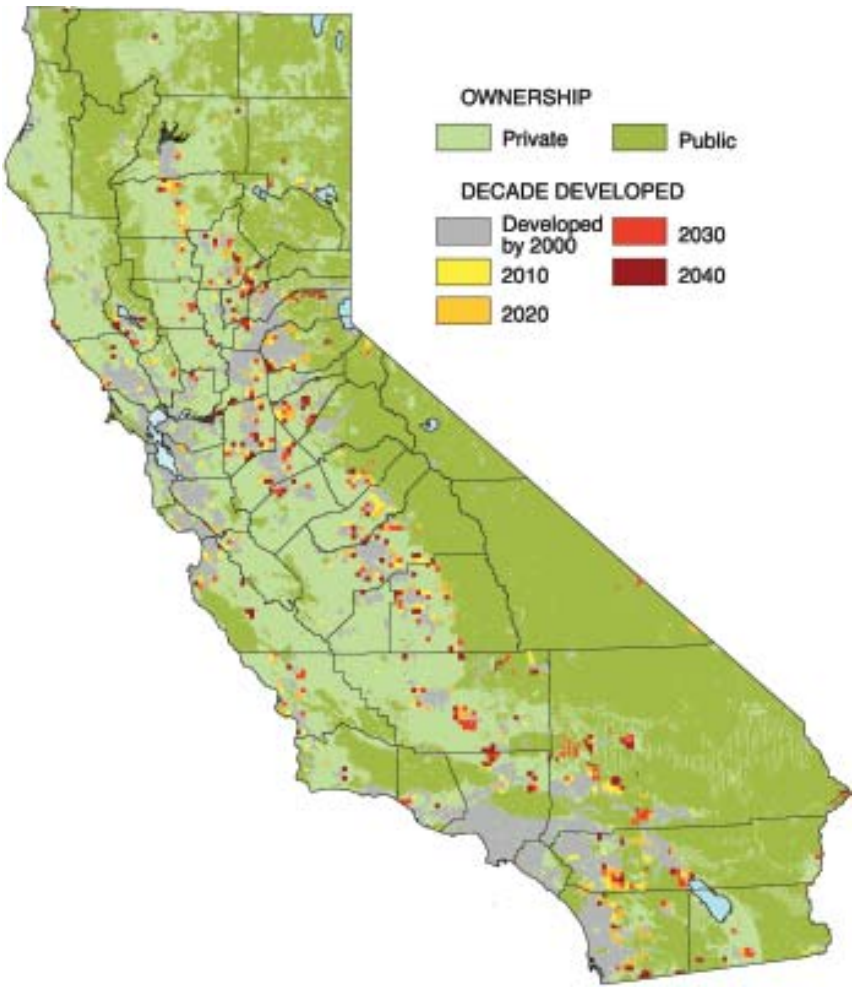
California's population continues to grow, spread geographically, and change socially. Although some rangeland areas of the state have not experienced heavy growth, residential development over the last decade has expanded into many other rangeland areas. Development of rangelands into parcels between five to 20 acres typically fits within most local zoning regulations but still represents a shift away from rangeland management. As a result of residential development, rangeland area has declined by tens of thousands of acres per year over the last decade. It is projected to continue to decline at similar levels through 2040 (Figure 7).

As this development occurs, rangelands in many locations provide added values beyond being a source of forage for grazing.. Rangelands buffer urban growth and provide open space and a variety of other values to metropolitan populations at relatively low cost. In an ef-

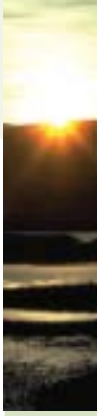
Several factors drive change on California's rangelands:

- **Low profitability of ranching**
- **Population growth impacts on land values**
- **Perceptions of the goods and services that are expected of rangelands.**

Figure 7. Projected housing development* by decade to 2040



** housing density of one or more units per 20 acres*
Source: FRAP, 2001; FRAP, 2002d; FRAP, 2003b



fort to maintain these values, there has been increased focus on keeping rangelands in larger tracts near urban areas. In some cases, efforts are providing opportunities for ranchers to continue operations and preserve the many ecological and social values offered by operating ranches.

In some cases, keeping larger tracts intact involves outright purchase. These large tracts often continue grazing operations at a reduced level and serve other rangeland values. A number of large ranching tracts have been acquired in recent years by governmental agencies, conservancies, and private parties that do not make a living from ranching. The taxpayer costs of acquisition and ongoing resource management are significant when the land is transferred to the public. In other cases, only the development rights are being purchased from the rancher while they maintain the use and control of the land for existing ranch uses. Ranchers themselves formed the California Rangeland Trust in 1997 to help maintain sustainable rangelands. Finally, preferential zoning and tax assessment laws such as Williamson Act contracts can provide a lower but often effective level of support to existing operations.

A variety of approaches are being tried to help maintain the range industry:

- **Preserving larger rangeland tracts**
- **Management of conflicts from urban pressure**
- **Improving economic opportunities**
- **More funding for restoration projects**
- **Help in meeting health requirements**
- **Facilitation of meeting public safety and environmental requirements.**

In addition to the preceeding approaches to keeping larger rangeland tracts intact and in production, a variety of other approaches is being tried to help maintain the range industry. These include management of conflicts from urban pressure; improved economic opportunities; more funding for restoration projects; help in meeting health regulations; and facilitation of meeting public safety and environmental requirements.

Even with a variety of available policy tools, urban pressure takes a toll on the attitudes of ranchers. A recent survey of ranchers in urban Contra Costa and Alameda Counties, and in rural Tehama County, suggests that urban ranchers fear local land use planning most and expect that if their ranch is sold it would be converted to urban land uses. In contrast, rural ranchers felt less threatened by local land use planning and wanted their property to be a productive ranch even if sold. Most of the ranchers enjoyed ranching and its associated family life, but felt that urban California was becoming more hostile to the livestock industry.

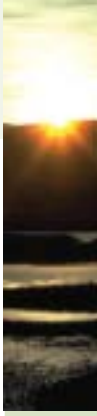
The range landscape in the coming decades could well entail a dynamic mix of larger ownerships devoted to livestock production intermixed with smaller ownerships managed for a wide variety of both livestock and non-livestock goals. Outside sources of income will be increasingly important. Development, especially in the form of the break-up of larger parcels into smaller parcels, will proceed. At the same time, more rangeland area will be controlled by governmental agencies, conservancies, and private parties that are not dependent on livestock production for revenue. In some cases, ranchers will continue to own the land and manage livestock on ranches where development rights have been ceded to a third party via conservation easements.

Even with the traditional ingenuity of California ranchers, ranching for the next decade will remain a challenge in some regions of the State. Still, many ranchers, especially in areas less subject to development pressure, will continue livestock operations. As such, they will be a critical factor in supporting working landscapes.

Highlighted Themes

Keeping pace with the changing California requires both an understanding of the complexities of forests and rangelands and the ability to continuously adapt to a growing and changing population. In addition to topics of historic and current interest, a number of new themes demand attention. Eight crosscutting themes have been identified by the 2003 Assessment. They are vital to sustainability and will continue into the next decade and beyond.

- **Integrate environmental, economic, and social goals:** The environmental sustainability of California's forest and rangelands is improving with growing inventories, diverse forest structure, and a greater attention to maintaining valuable biological legacies. Continued progress will require continued investment and innovation in resource management from both the private and public sectors. Private sector investment in land ownerships and businesses selling goods and services generates employment and local government revenues in rural areas but is dependent on continued market-based profitability. Public sector investments are dependent on the financial support of an increasingly urban population especially their social values to both urban and rural communities and stakeholders.
- **Conserve the Working/Private landscape:** The Working/Private landscapes are those lands managed for a wide range of purposes with commodity production as the major economic basis for ownership. Historically, the Working/Private landscape has provided commodities, jobs, open space, and ecological services to the public at little direct cost. These lands have a history of investment and active management. With limited public understanding of management activities, low profitability for timber and livestock operations, and increasing regulatory costs the strong pressures for parcelization, fragmentation, and land use conversion accelerate. New ways to keep the Working/Private landscape viable while providing a wide range of public values are necessary.
- **Improve watershed conditions:** Improving watershed conditions is vital to restoring functional ecosystems across California. Many watersheds have historic legacy impacts, ongoing land use changes, and episodic intense wildfire that degrade water quality and aquatic habitat conditions. In degraded watersheds, a key policy challenge includes addressing linkages between current land uses, natural catastrophic events, and investments in restoration.



- **Reduce wildfire threats:** High fuel loads, the growing extent and intensity of wildfires, and increased population in forests and rangelands all increase the risk of wildfire to people and resources. This threat requires continuing focus on the management of forest and rangeland fires, both catastrophic wildfire and prescribed burns.
- **Reduce loss of productivity and forest health from increased stocking levels:** Timberland growing stock volumes and densities have been increasing as a result of reduced harvesting (most noticeably on federal lands) and exclusion of wildfire. While this trend has had beneficial impacts for many terrestrial and aquatic habitats it has also led to an increasing inventory of unutilized timber and dense forest stands. This results in a lost opportunity to generate wood products used by Californians, and also increases detrimental impacts such as insect and pest outbreaks, catastrophic fire, and the loss of biological diversity for species dependent on open, less dense forest settings.
- **Meet the complexities of management in metropolitan forests and rangelands:** Forests and rangelands near urban centers, along with those adjacent to rural communities, are the most visible and are of the greatest value to the people near these areas. Management is needed for forest health improvement and wildfire risk reduction. Addressing the diverse social concerns is necesary to integrate positive experiences into the lives of neighbors.
- **Address continued residential land use pressures:** Land conversion for new housing continues on rangelands and forests near metropolitan areas and in the wildland urban interface. Most of the development has a low density of houses per acre so the land impact is considerably greater than the population impact. This type of development removes natural vegetation and breaks rangelands and forests into smaller units. This reduces habitat value for wildlife species dependent on unfragmented natural vegetation and makes it more difficult to manage the remaining larger parcels. California's population will continue to expand and will need to be accommodated with the least negative impact to a high quality and safe environment.
- **Improve policy coordination and integration:** Multiple regulations often impede progress towards desired goals, discourage investment, incur substantial taxpayer funded regulatory costs, and add uncertainty that increases costs to landowners and other stakeholders. Better coordination and integration will be essential to effectively match appropriate tools to the many challenges.

Policy Challenges and Options

Policies that surround forest and rangeland issues in California address two different but related facets. One is to maximize the amount and usefulness of services and commodities for all Californians. The second focuses on protecting, maintaining, and improving the underlying ecosystems. In each case, two questions arise concerning equity, for both today and the future. Who will pay for these programs and who will benefit?

The most general goal of forest policy can be described as finding a mix of investments and programs that are widely acceptable and lead to levels of biological diversity, commodity production, social well being, and environmental quality that are widely acceptable. To keep abreast of the many challenges to sustainability, California's forest and rangeland policy must improve by utilizing a wide range of options and tools (Figure 8).

Figure 8. Policy challenges and options

Challenges		Options and Tools
1 Biological Diversity	Gaps in wildlife habitat structure Decline in some native species Using all landscapes to meet biological diversity goals	Acquisition or partial purchase Application of new technology Collaborative decision making processes Conservation easements Conservation incentives and cost share programs Cooperative management Education and technical assistance Increased reliance on imports Information development and sharing Joint monitoring Land use planning Long-term plans Market agreements Multiple-commodity management Private management and investment Regulatory innovation Revenue from new goods and services
2 Productive Capacity	Declining land base and administrative withdrawals of land available for timber and range production Risks and Impacts from increased forest stocking levels Decline in rangeland area and availability	
3 Forest Health	Managing forest structure for productivity, habitat, and forest health goals Management of metropolitan and interface forests and rangelands Public understanding of management practices Forest and rangeland conversions Fuels buildup risks to ecosystems and human assets Elevated pest damage related to forest stocking levels Emerging pest and disease threats to unique habitats and livestock health Impacts of exotic and invasive species to biological diversity and rangeland productivity Increasing air pollution in several regions	
4 Soil Conservation and Water Quality	Measuring cumulative watershed impacts Improving watershed condition and restoring fish habitat	
5 Forests and Climate	Understanding and responding to climate change	
6 Socio–Economic Well Being	Increasing consumption and statewide limitation on California commodity output Meeting changing demands for recreation and open space Meeting costs of resource protection Incentives for private production of ecosystem services Maintaining large landholdings in resource industries Weak economies in rural communities	
7 Governance	Complexity of regulatory oversight Limited policy integration Conflicts over forest and rangeland management practices Coordination in research and information sharing Standardized, comprehensive information systems	